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ATMOSPHERIC DUST AND AEROSOL STUDY

Data Report

by

Reinhold Reiter,
Hans Müller
and Rudolf Sladkovic

April 1981

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EUROPEAN RESEARCH OFFICE
United States Army
London, England

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Fluorescent particle tracer experiments have been conducted to study the dispersion processes in the north-alpine Loisach River Valley for a variety of meteorological conditions including inversion cases. This report summarizes the details of the experiments and presents all results, in particular the particle concentrations measured at various downwind locations by H-shaped Rotorod samplers together with the relevant meteorological conditions, in tabular form. The report is intended to serve as a data base for further analysis.		

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ABSTRACT

Fluorescent particle tracer experiments have been conducted to study the dispersion processes in the north-alpine Loisach River Valley for a variety of meteorological conditions including inversion cases. This report summarizes the details of the experiments and presents all results, in particular the particle concentrations measured at various downwind locations by H-shaped Rotorod samplers together with the relevant meteorological conditions, in tabular form. The report is intended to serve as a data base for further analysis.

1. INTRODUCTION

1.1. General

This Data Report is preceded by four reports (see list of reports on the Loisach River Valley tracer field studies page 19), containing first the geographical conditions under which the field experiments took place, further the technical equipment used in operation, and finally step by step the first results of the tracer experiments and of simultaneously performed meteorological measurements. Some theoretical evaluations have likewise been reported.

The purpose of the present Data Report is to describe the experimental design - following the survey of literature relevant to our subject (1.2.) - and to present all measured data in tabular form according to a uniform scheme, thus allowing interested research groups to readily use our data for further treatment.

This data collection is preceded by:

- i. a detailed description of the topography of the terrain where the measurements have been made;
- ii. experimental particulars of the tracer material, of the aerosol generator and of the samplers used;
- iii. Guide for the use of the data compilation.

We intend to process the present data theoretically in a separate, additional study (after submission of a proposal) within the frame of an extended Gaussian model.

At this point the first author wishes to point out that the feasibility of the experimental study was based on two requirements:

1. The interest of the research group at US Army Dugway Proving Ground, Utah (later White Sands Missile Range) where we are particularly indebted to Don L. Shearer as initiator and Mr. H.E. Cramer, and
2. the existence of an isolated and centrally located hill (peak 300 m above the valley floor) at the opening of the Loisach Valley to the pre-alpine region. This hill enabled us to operate on its peak the aerosol generator provided to us by the US Army Dugway Proving Ground and to release the aerosols downwind into the valley.

I should like to express my sincere thanks for any kind of help rendered to us, especially for many fruitful discussions at the Dugway Proving Ground.

1.2. Survey of Literature with Conclusions as to the Concept of our Studies in the Loisach Valley

Describing the short-term dispersion of air pollutants the most widely used concept relies on the Gaussian plume model (e.g. Stern et al., 1973) and, along with this, on appropriate 'turbulent diffusion-typing schemes' (more recently reviewed by Gifford 1976 a,b). Since this semi-empirical approach largely depends on stationary and horizontal homogeneous flow patterns, its successful use is preponderantly restricted to flat terrain, where those well-behaved air currents are governed 'to a good degree by the pressure, Coriolis, frictional and buoyancy forces' (Kao et al., 1974).

In mountainous terrain, however, a large variety of thermally and orographically induced 'local windsystems' (e.g. Defant 1951; Flohn, 1969; Yoshino, 1975) may additionally develop, and the complexity of these terrain-dominated flows often degrades predictions by the Gaussian plume model (or comparable assessment techniques) to those of minor or minimal credibility. There is an urgent need, therefore, to develop appropriate terrain-related diffusion and transport models and, in supporting this, to intensify the experimental research on 'terrain-induced airflow phenomena' (Barr et al., 1977).

Of special interest in this connection are tracer field studies. Very valuable insights into the plume behavior, especially in the case of deep canyons, have been gained so far by Start et al. (1974, 1975), Hovind et al. (1974) and, more recently, by Archuleta et al. (1978). Start and co-workers, e.g., when comparing measured canyon dilutions with 'standard flat terrain curves' (according to the usual Pasquill-Gifford (PG) categories), found the observed concentrations systematically lower, with differences ranging from a factor of 1.4 (during moderate to strong temperature lapse, B category) to about 5 (for neutral stability, D category) to 15 (during strong inversion stabilities, F category). Similar departures are reported by Hovind et al. for 'the canyon site A' with the respective factor amounting to about 10 for conditions of category F ('stagnation conditions' in the winter), see also Gifford (1976a). Some controversy has been raised by Tank (1976), who, in reexamining the results of Start et al. (1975), demonstrated the D category classified cases to be better represented by conditions 'intermediate to C and D stability' and who succeeded in showing 'a near perfect (in a statistical sense) agreement between theory and observation' when the appropriate version of the Gaussian plume model is applied to the data. According to Tank this agreement is not too surprising when considering that 'only

those disturbances of scales comparable to, or less than, the dimension of an actual effluent plume can contribute to plume diffusion', or when realizing that enhanced diffusion rates may only be expected if 'topographically induced flow disturbances can actually begin to participate in the diffusion process'.

In intermediate topographic settings, e.g. in case of mountain-valley terrains, well-ordered airflow patterns with marked divergence fields may be involved in the dispersion. This has been particularly well demonstrated by Kao et al. (1974), who investigated the windfield in the Salt Lake Valley area and, in this frame, studied the propagation of 'marked air particles' (by trajectory analysis methods). Kao et al. found the rate of diffusion varying in time and space within a mean motion strongly affected by the mountain-valley winds. Thereby, horizontally convergent flow has been ascertained with mountain winds, and horizontally divergent flow with valley winds. Fosberg et al. (1976) also point to this topic and propose a 'divergence correction' to be applied to the Gaussian plume model. The authors show that for realistic estimates of the 'toposcale' divergences this term would reduce the concentration maximum by a factor of more than 2. Reid (1979), who studied the propagation of ice nuclei in the Eagle River Valley near Climax (Colo.) during winter months, draws attention to the frequent occurrence of 'shallow diabatic flows' developing under very stable conditions ('capping inversions') and, with regard to these conditions, doubts the successful applicability of the Gaussian models to 'mountain-valley dispersion problems'. The special behavior of temperature structures in a deep mountain valley (Gore River Valley near Vail, Colo.), especially the destruction of the ground-based inversion after sunrise, has been investigated by Whiteman and Mc Kee (1977). The importance of the observed 'descent of the top of the inversion' with regard to the dispersion of air pollu-

tants has been elucidated by the same authors in a more recent paper (Whiteman and McKee, 1978). Therein, a new model - relying on the 'inversion descent hypothesis' - is described, which allows the prediction of the time-dependent concentration along the sidewalls, and which is a promising attempt to consider well-founded results on the matutinal break-up mechanism of nocturnal ground-based inversions.

Although considerable progress in understanding the fundamental processes in mountain diffusion meteorology has thus been achieved in recent years, there is a definite lack of specific tracer field studies especially in 'normal', medium-sized, mountain valleys.

The Loisach River Valley, with the Institute for Environmental Research being located near its head, belongs to this type of valley. It is U-shaped, 20 km long and 2 km wide and is located approximately 100 km south of Munich (Figure 1). It is characterized by a distinct mountain-valley wind system (Reiter, 1965), with daytime north-eastern (NE) up-valley winds and nighttime south-western (SW) down-valley winds. During the period between May 1975 and July 1976, fourteen diffusion experiments were carried out in this area. Fluorescent particles were used as atmospheric tracer and an array of H-shaped Rotorod samplers as collecting system. The plan to accomplish tracer measurements has been considerably promoted by the existence of an isolated hill (300 m abg) in the immediate vicinity of the valley entrance (Figure 3), an unique topographical feature inviting to release the tracer from its top. With the tracer released at the valley entrance our primary objective has been to investigate the aerosol transport along and across the valley under a variety of characteristic, but different, meteorological up-valley wind conditions.

Generally, most samplers were installed at various downwind

locations at the valley floor, in several cases, however, some few devices were also run at selected mountain sites (Wank peak and sites labeled by roman numbers (I - VI) in Fig. 1).

For each experiment comprehensive meteorological information was provided: i) by the permanent meteorological measuring facilities at the Institute (indicated by an 'I' in Fig.1) and the surrounding high mountain observatories Wank and Zugspitze; ii) by special pibal tracking (windfield) and radiosonde ascents (temperature) at several locations in the valley prior to, during and after each experiment (the arrangement may be seen from Fig.4). Cloud cover, radiation conditions and other relevant parameters were also included to gain further insight into the diffusion meteorology.

2. SITE DESCRIPTION

The topographical features of the Loisach River Valley suggest a distinction of the main valley into two parts (Fig.1):

The northern part extends from the northern end of the Garmisch basin to the Höhenberg 'release' mountain (indicated by an 'H' in Fig.1). Length, width, and relative ridge-height of this SSW-NNE oriented section amount to 10 km, 1800 m and 1000 m, respectively. The valley widens immediately north of the Höhenberg and then enters the 'Murnauer Moos' fen or the Bavarian pre-alpine region in a funnel-shaped way.

The Garmisch basin may, on the other hand, be conveniently defined as the area enclosed by the 800 m contour-line and the line segment Wank-Kramer. Hence, the Garmisch basin shows a considerably deviating direction, it runs from WSW to ENE, is 7 - 8 km long and approximately 2 km wide. In the south it is surmounted by several ranges of the Wetterstein massif

with the Zugspitze (3000 m a.s.l.) being its highest peak. Since the main ridge raises to 2600 m height or almost 2000 m above the valley floor, the southern ranges are by far the highest of all surrounding mountain chains including those of the Kramer complex in the northwest.

The walls of the main valley are forested up to the timberline at about 1700 m a.s.l.; the sloping, however, varies considerably from place to place, only the eastern flank (Estergebirge) of the northern part shows a fairly homogeneous structure with an inclination of approximately 30° to a height of 1300 m above the river.

The nature of the valley floor is characterized by meadows, small forests and urban districts (Fig.2) marking this area as one of considerable inhomogeneous aerodynamic roughness.

This description is completed by two pictures taken from different locations: Figure 2 shows the view from the Höhenberg over the northern part of the valley elucidating both the patchiness of the valley floor and the afforestation of the walls. Conversely, Fig. 3 shows the view from the Wetterstein range towards NE, thereby demonstrating the isolated location of the Höhenberg ('H') at the valley entrance.

3. EXPERIMENTAL DESIGN

3.1. Tracer Material

The tracers were zinc sulfide fluorescent particles (FP) from the United States Radium Corporation (USCR).

The tabular survey shows the main material properties: Color, particle density PPG (particles per gram), mass median diameter MMD, and the particle size distribution.

Type: 2210 Green/Lot H-1096
 PPG : 0.91×10^{10}
 MMD : $3.6 \mu\text{m}$

<u>Diameter (Microns)</u>	<u>Percent</u>
< $0.75 \mu\text{m}$	5.0
$0.75 - 5.5 \mu\text{m}$	92.9
> $5.5 \mu\text{m}$	2.1

Physical characteristics of FP tracers

This type of material was used in the first 8 experiments, thereafter another lot (Lot 15) with similar characteristics (PPG = 0.92×10^{10} , MMD = $3.2 \mu\text{m}$ was used).

3.2. Release

The dissemination of the aerosol was accomplished by a Metronics Model 8 Blower Generator of the series 'widely used in the field' (Leighton et al., 1965). With regard to the forested area, however, a direct release was inappropriate. Instead of this, the particles were released via a tube extending to the tree top height (8 m). The 'blowing nozzle' at the tube's end can be seen from Fig.2.

Following Leighton et al. (1965) and, therefore, denoting 'the number of particles made airborne per unit weight by F_s and the weight of FP fed through the generator by W , the source strength or the number of particles released is given by the product $W \cdot F_s'$. Hence, the release rate is $Q = (W \cdot F_s) / \tau$ or

$$(1) \quad Q = \frac{W}{\tau} \cdot F_s'$$

τ being the duration of the release.

With τ varying between 40 and 60 min, a constant feed rate of

$$(2) \quad \frac{W}{\tau} = 85 \text{ g min}^{-1}$$

was used in all experiments assuring sufficient coverage in all cases.

Assuming a dispersal efficiency close to unity, F_s is approximately reflected by the 'number of primary particles in the undispersed state (PPG)' (Leighton et al, 1965). Hence, with the PPG-values of the tracer material used, the emission rate Q is obtained as:

$$(3) \quad Q = 1.3 \times 10^{10} \text{ particles s}^{-1}.$$

In the further treatment of the data, e.g., when deriving the relative concentrations S/Q , this value is to be used for all experiments.

3.3. Sampling

Tracer samples were collected using H-shaped Rotorod samplers. These were no Metronics fabricated devices but, in fact, the Metronics standard type (as described by Grinnell et al., 1965, or Leighton et al., 1965) was reproduced by our laboratory, with a total of 20 devices.

According to the operational design, i.e., 'with two collecting surfaces of $A = 0.38 \times 60 \text{ mm}^2$, a rotation radius of 60 mm and a rotation speed of 2400 rpm (corresponding to a speed of the collector arm of $v = 2\pi \times 6 \cdot 40 \text{ cm/s} = 15.1 \text{ m/s}$)' (Leighton et al., 1965), the apparent sampling rate $F'_r = 2 \cdot A \cdot v$ is estimated to

$$(4) \quad F'_r = 41.3 \text{ l min}^{-1}.$$

This value is modified by considering the Rotorod efficiency η , which amounts to about 65% for the particle size range used in these experiments and with rods coated according to standard procedures. Hence, for actual dosage determinations the true sampling rate $F_r = \eta \cdot F'_r$ is to be applied, namely:

$$(5) \quad F_r = 26.9 \text{ l min}^{-1}.$$

Before each experiment the collector arms of the Rotorods were 'manually coated' with special silicone grease according to the recommended standard procedure (e.g. Grinnell et al., 1965).

During the experiment all samplers were fixed to metal posts at approximately one meter above the ground, as is common practice in comparable field trials (e.g. Archuleta et al., 1978).

The samplers were operated on specially designed 9-volt d.c. battery systems providing constant rotation speeds (with a constancy better than that of the standard version ($\pm 2\%$) during a several hours run).

The samplers were energized just prior to a release. After cloud passage the period of operation was 'held to a minimum in order to avoid obscuration of FP by atmospheric particulates deposited after cloud passage' (as has been recommended by Leighton et al., 1965).

3.4. Assessment

After each experiment the particles on the collector rods were counted by means of a Zeiss microscope of magnification 160x (10 x eyepiece and 16 x objective of 0.35 N.A.) with incident UV light (to excite the fluorescence).

In most cases the population proved to be of low density (with particles less than 1000) and, therefore, no 'specific area counting with reticle grids' (as is common practice in case of medium and high-density rods, e.g. Archuleta et al., 1978; Leighton et al., 1965) was applied in visual counting, but the entire collecting surface was scanned to obtain the total count.

3.5. Errors

The operational errors inherent in the FP technique have been carefully studied and reviewed by Leighton et al., (1965).

According to this, in dissemination with the blower generator, the main error in source strength determinations originates 'in the uncertainty of the value used for F_s '. This error, expressed in terms of 90% confidence intervals, was found to be of the order of $\pm 5-10\%$.

The random errors in sampling and assessment typically prove to be in the order of $\pm 10-12\%$ (for 300 particles counted). These values of the 90% confidence intervals, which are based on 'close array experiments and an assumed Poisson distribution', increase to approximately 20% and 30% for particle counts of 100 and 30, respectively; sample counts of fewer than 10 particles are recommended to 'be regarded as not significant'.

We found the differences in the counts of the two collecting surfaces (whose sum yields the total count) within these limits.

4. DATA SUMMARY

4.1. General Survey

A survey on the experimental specifics - release data, meteorological conditions, number of samplers at different areas of interest - is given in Table 1.

As to the propagation meteorology, the stability class was determined by the most widely used diffusion categorization scheme discussed by Pasquill (1961) and Turner (1961), and the mean flow was specified by an average wind speed between ground level and 300 m height (source level) deduced from the pibal measurements. According to this, the stability ranged between B and D categories, and the windspeed varied between 3 and 7 m/s. Most (10) experiments were conducted during the summertime with well-developed up-valley winds, whereas the remaining four experiments represent winter/spring cases with partly complex meteorological conditions (inversion structures and in one case (No.12) unsteady winds).

The column 'number of samplers at....' in Table 1 was added to show at a glance what part of the area had been of primary interest in the specific experiment.

Anticipating the more detailed Tables I - XIV, Table 2 surveys the experiments with three and more samplers at the mountain sites (the locations are specified in Fig.1 by roman numerals from Wamberg I to Kreuzeck VI). The table is intended to show the orders of magnitude of the mean concentration S [particles m^{-3}], where S is defined as the quotient of measured true dosage and sampling time (duration) τ (see 4.2.). The comparison with the (maximum) exposures at the Garmisch basin (valley floor) indicates, that occasionally substantial particle concentrations may be found at the mountain sites even at considerable lateral distances (in the last column y

denotes the lateral distance from the ground-level plume centerline); in case of experiment No.13 the concentration was even higher at most mountain sites. Appropriate interpretations are only possible with the results from auxiliary aerological soundings.

4.2. Contents of Tables

The results of the 14 experiments are summarized in Tables I - XIV, with all tables designed in the same way.

The upper part of each table contains information on the duration of emission, the mainly investigated area, and the meteorological conditions.

To specify the windfield, the results from the individual pibal stations - with bases at normally two locations (depending on the area of primary interest) - are included; the respective mean values are denoted by \bar{u}_1 and \bar{u}_2 and were used to derive the mean windspeed U . Since the aerological results have been extensively illustrated in previous reports, none of those figures have been reproduced here; to complete the compilation they are frequently referred to in the tables, however. In order to facilitate a search, the respective report is referred to at the legend to each table.

The data of the tracer measurements are summarized in the lower part of each table.

The positions of the individual samplers (denoted by capital letters) are orientated at the ground-level plume axis (time mean path) and defined by the distances 'along the axis (x)' and in the 'lateral direction (y)'. A topographical map (scale 1:25 000) has been used to localize the plume centerline (location of maximum exposure).

Figures I - XIV show the respective centerlines together with the sampler locations and the particle counts for each experiment. The tabular description of the sampler locations is completed by the columns 'altitude above sea level' and 'height difference source - sampler'.

The particle counts are denoted by D_τ , where the sampling time τ (min) is indicated by the index.

The particle counts D_τ were used to determine the mean particle concentration S_τ according to:

$$(6) \quad S = \frac{D_\tau}{F_r \cdot \tau} ,$$

where $F_r = 26.9 \text{ l min}^{-1}$ (see Eqn.5).

In the tables, S_τ concentrations are converted into particles m^{-3} .

When discussing dosage or concentration measurements, the Gaussian plume model is often used as reference. This frame implies the incorporation of (empirical) dispersion coefficients, whose values are, however, mostly based on sampling or averaging times of about 10 min (e.g. Turner, 1970). In order to provide a data set which may conveniently be compared with standard model entries, the S_τ concentrations were converted according to:

$$(7) \quad S_{10} = S_\tau (\tau/10)^{0.2} , \tau [\text{min}].$$

In case of $\tau = 60 \text{ min}$, the S_{60} values have to be multiplied by 1.43, a conversion factor well known in diffusion meteorology.

The last column contains the product $S \cdot U$ with units of a particle flux, $\text{P}/(\text{m}^2 \text{s})$. Using the emission rate Q (see Eqn.3, page 9) one immediately obtains the 'wind-speed-normalized

relative concentration' SU/Q (with units of m^{-2}), which may be the most convenient entry when comparing dilution rates.

5. FINAL REMARKS

The data set of FP tracer dosages obtained from samples at ground level (valley floor) and surrounding mountain sites provides a base for further analysis of the dispersion processes in a mountain valley for a variety of meteorological conditions including inversion cases.

Since the dispersion is believed to be related not only to small scale turbulence but also to 'organized' divergence fields occurring within the mesoscale mountain-valley wind circulation (e.g. Fosberg et al., 1976), any forthcoming data analysis should consider this aspect.

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List of reports pertaining to the
Loisach River Valley tracer field studies

1. Reiter, R., 1974: Boundary layer aerosol transport measurements in a valley system;
Final Technical Report, Contract Number
DAJA 37-73-C-1806.
2. Reiter, R., 1975: Boundary layer aerosol transport measurements in a valley system;
Final Technical Report Part II, Grant Number
DA-ERO-124-74-G0054.
3. Reiter, R., and Sladkovic, R., 1976: Boundary layer aerosol transport measurements in a valley system;
Final Technical Report Part III, Grant Number
DA-ERO-75-G042.
4. Reiter, R., Sladkovic, R., and Müller, H., 1977: Atmospheric dust and aerosol study;
2nd Status Report, Grant Number DAERO-76-G-035.

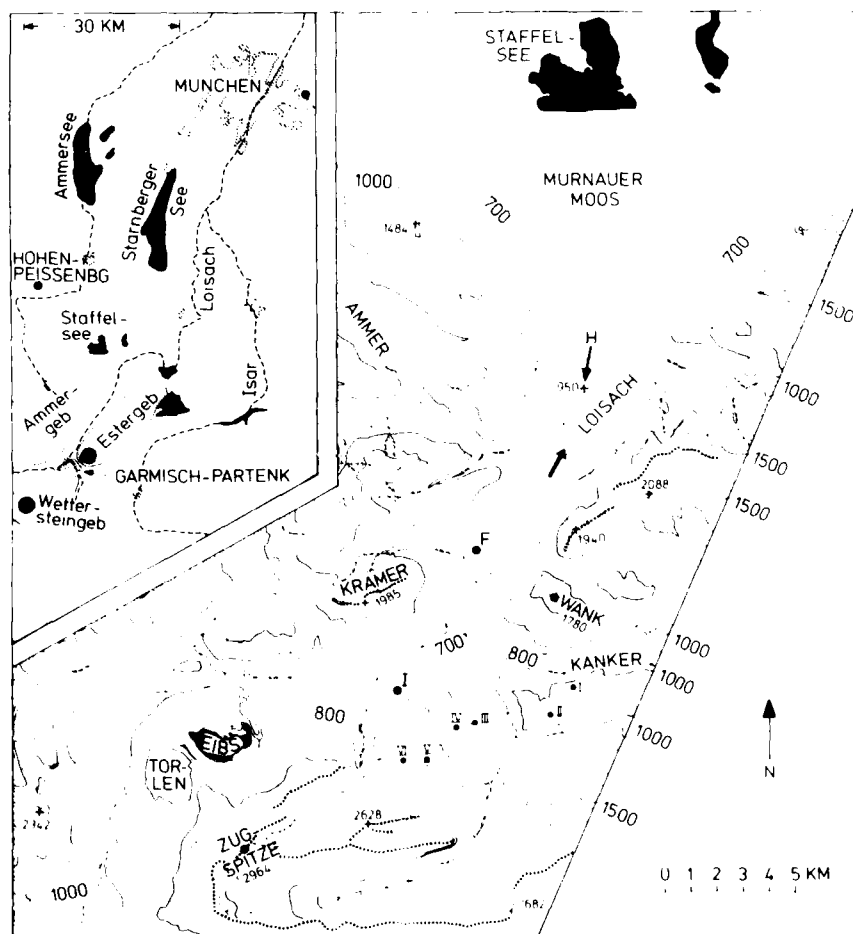


Figure 1: Map of the Loisach River area with contour-lines (m) drawn in 100 m intervals. Tracer was released at the Hohenberg mountain 'H'. Samplers were located at the valley floor and at mountain sites (Wank peak and site numbered I-VII). The Institute is indicated by the letter 'I'. Dashed lines: River and creeks. Dotted: ridge lines.



Figure 1. Aerosol release from the valley floor.



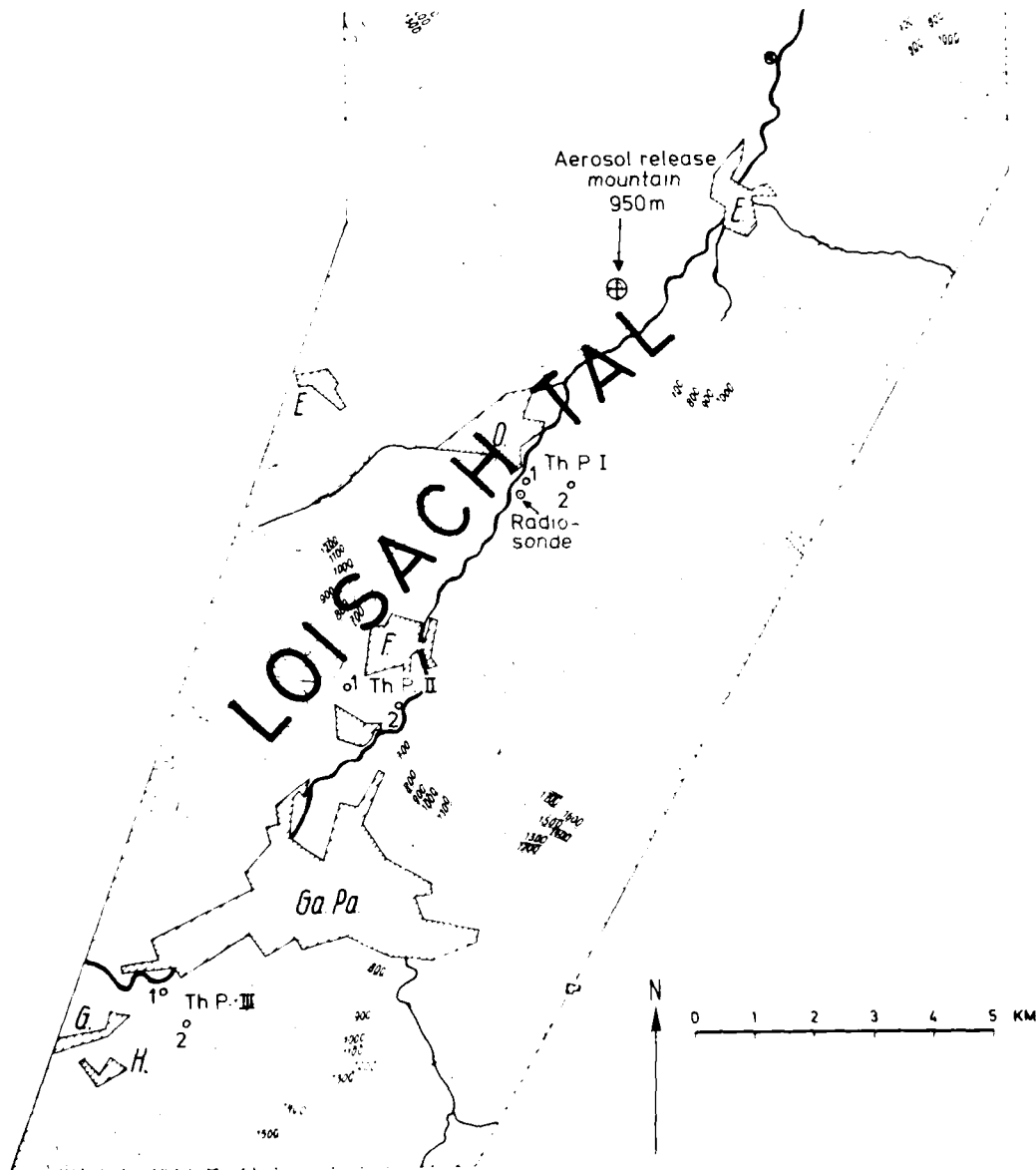


Figure 4: Sites of theodolite stations (Th.P. I-III),
 theodolite station (Th.P. I-III),
 and the aerosol release mountain at Base I.

Table 1: General survey on the experimental specifications.

Number	EXPERIMENT			Meteorological conditions		Number of samplers at		
	Date	Time (UTC)	Duration (min)	Stability class	Wind speed (ms ⁻¹)	Northern part of the valley	Garmisch basin	Mountain sites
1	18 May 75	12:45	60	D	3.0	18	1	1
2	20 Jun 75	11:00	60	C(B)	6.0	18	1	1
3	7 Jul 75	11:10	60	F	5.5	18	1	1
4	9 Jul 75	11:50	60	C(D)	4.5	13	5	-
5	25 Jul 75	12:04	60	F	6.0	19	-	1
6	28 Jul 75	12:00	40	C(B)	6.5	7	7	5
7	6 Aug 75	11:30	40	C(D)	6.0	4	10	6
8	13 Aug 75	12:00	40	C	5.0	4	10	6
9	11 Nov 75	12:45	40	D	5.5	20	-	-
10	16 Dez 75	13:00	40	-	-	20	-	-
11	8 Mar 76	11:30	60	D	5.0	20	-	-
12	14 Apr 76	10:15	45	C	-	20	-	-
13	28 Jun 76	11:00	45	F(C)	6.0	6	9	5
14	7 Jul 76	10:30	60	F	7.0	8	9	3

Table 2: Mean particle concentration S (particles m⁻³) at the mountain sites and the valley floor (Garmisch basin) for experiments with three and more samplers at the mountain sites. In the last column, the lateral distance from the ground-level plume axis (time mean path) is denoted by y . All heights in meters above sea level.

Nr.	EXPERIMENT			Wank	Wankberg	Heldbacht	Kayertal	Garmischer-Tal	Krauzloch	Krauzloch	Garmisch-Basin	y
	Date	Duration (min)	Stability class	1280 m	1050 m	1200 m	1240 m	1310 m	1500 m	1650 m	1770 m	(m)
6	28 Jul 75	40	C	-	47	33	73	-	126	118	450	3500
7	6 Aug 75	40	C	26	-	49	158	157	100	144	520	3000
8	13 Aug 75	40	C	20	-	21	90	96	91	114	350	4000
13	28 Jun 76	45	F	-	-	64	193	220	240	256	100	0
14	7 Jul 76	60	F	-	-	0	(19)	(19)	-	-	80	4000

PRESENTATION OF ALL
EXPERIMENTAL DATA

Right side : Tables (I-XIV) - Data Summary

Left side : Figures (I-XIV) - Each figure gives
the location of the ground-level plume
axis (time mean path) according to the
particle counts of the individual
samplers for experiments (1-14).

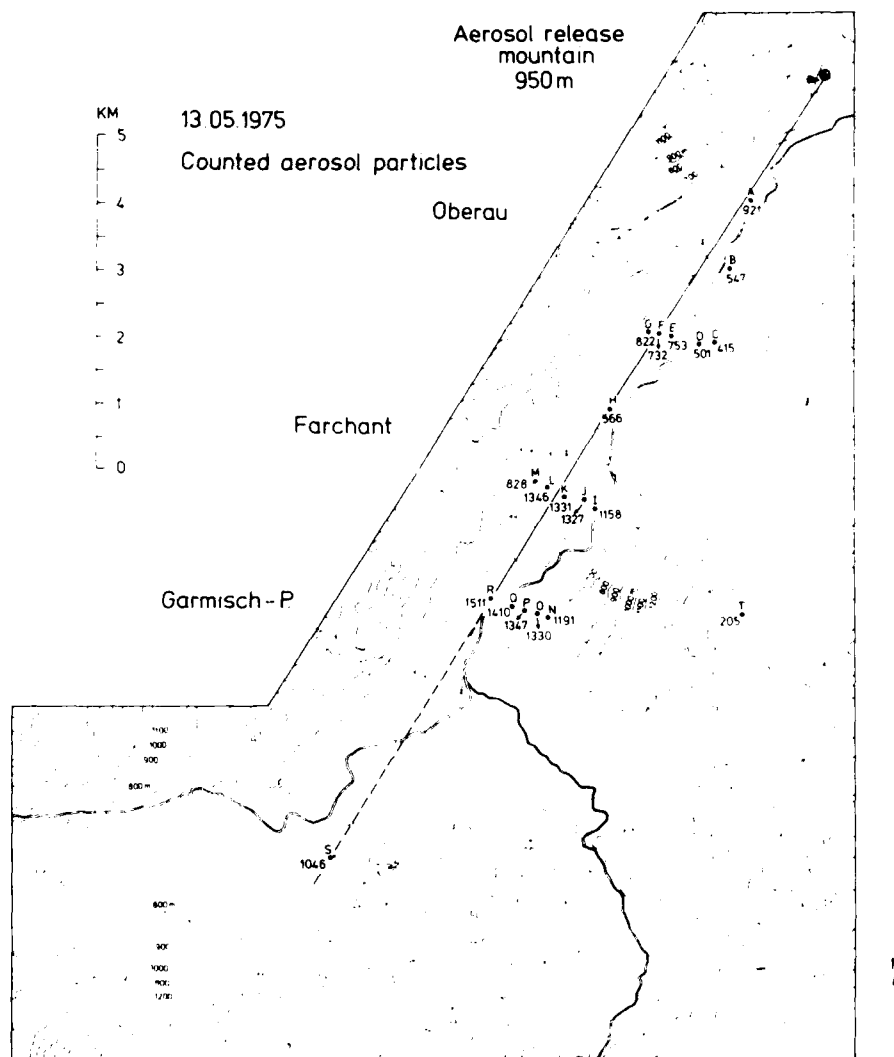


Fig.1

TABLE 1: EP - TRACER EXPERIMENT NO. 1 (16). SEE REPORT No. 5.

Date : 15 May 1975
 Duration of emission : 17.5% - 25.7% (E) = 6 min
 Area : Northern part of the valley
 Wind direction : NW (120° - 130°)
 Mean wind speed between ground level and 300 m height : $U = 3.0 \text{ m/s}$
 Cloud cover / height : 8/10 - 10/10 (at 1000 - 1900 m) = 1.1
 Atmospheric stability : Neutral (disp. =)
 Stability class : 1

Wind speed (m/s) : $\bar{u}_1 = 3.0$
 Accent : $R = E + G = 0.5$
 Farchant : $\bar{u}_2 = 3.5$
 D = H - I = 0.4
 Mean : $U = 3.0$

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 40 min	Derived (P) - concentration 40 min	Particle (P) - Flux
	X (m)	Y (m)				$\frac{N_{40}}{P \text{ per m}^2}$	$\frac{S_{40}}{P \text{ per m}^2}$	$\frac{S_{40}}{P \text{ per m}^2}$
A	2150	75	650	300	921	921	817	1451
B	5150	375	653	297	947	947	485	1493
C	4200	775	655	295	915	297	508	1104
D	4350	600	655	295	901	711	945	1330
E	4475	200	659	291	755	907	698	1004
F	4550	0	662	288	752	994	660	1447
G	4625	-125	662	288	871	910	720	1167
H	5900	0	667	283	906	906	502	1400
I	7275	600	677	273	1198	718	1077	6081
J	7250	400	677	273	1327	825	1177	6931
K	7375	175	678	272	1351	820	1160	6940
L	7375	-125	683	267	1340	830	1190	6960
M	7625	-575	686	264	828	913	754	1130
N	9050	875	692	258	1191	757	1080	6100
O	9100	725	696	253	1250	757	1180	6940
P	9150	525	698	251	1267	757	1164	6980
Q	9200	325	697	252	1241	757	1150	6960
R	9250	125	697	253	1211	757	1140	6920
S	13800	0	700	250	1200	757	1070	1280
T	14000	0	700	250	1200	757	1070	1280

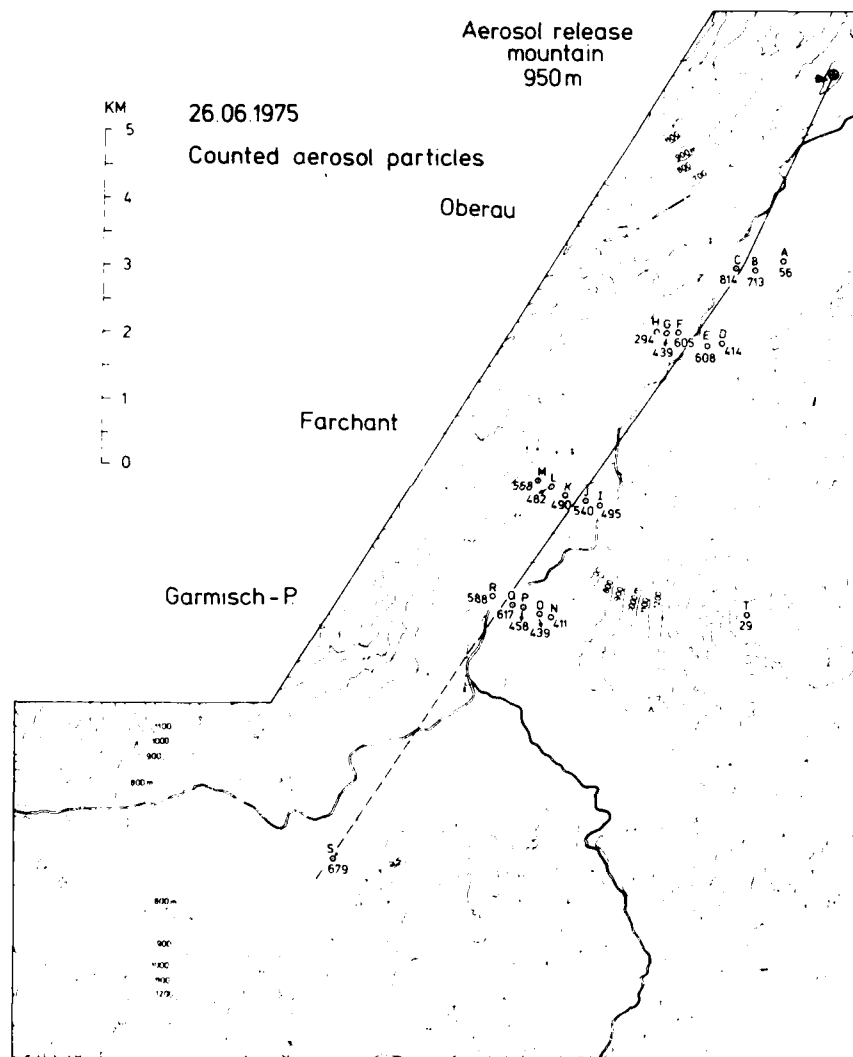


Fig.II

TABLE II: FP - TRACER EXPERIMENT NO. 2 (FIGS. SEE REPORT NO. 3)

Date : 26 June 1975
 Duration of emission : 11.00 - 12.00 CFT (60 min)
 Area : Northern part of the valley
 Wind direction : N - NE (Figs. 15, 16)
 Mean wind speed between ground level and 300 m height : $U = 6.0$ m/s
 Cloud cover / height : 1/10 - 2/10 Cu / 2000 - 2500 m a.s.l.
 Atmospheric stability : slightly unstable to unstable (Fig. 17)
 Stability class : C (B)

Wind speed (m/s) Ascent (Fig.)
 Oberau : $\bar{U}_1 = 5.5$ B - F - G (12)
 Farchant : $\bar{U}_2 = 6.5$ D - I - J (13)
 Mean : $U = 6.0$

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 60 min	Derived (P) - concentration/10 min	Particle (P) Flux
	X	lateral direction Y						
	(m)	(m)	n (m)	h (m)	D_{60}	S_{60} (P per m ³)	$S_{10} = S$ (P per m ³)	SU (P/m ² s)
A	2850	500	653	297	56	35	50	300
B	3150	200	653	297	713	442	632	3792
C	3250	-75	653	297	814	505	722	4332
D	4300	400	655	295	414	257	368	2208
E	4450	250	655	295	608	377	539	3234
F	4525	-250	659	291	605	375	536	3216
G	4625	-375	662	288	439	272	384	2334
H	4700	-500	662	288	294	182	260	1560
I	7325	325	677	273	495	307	439	2634
J	7375	125	677	273	540	335	479	2874
K	7500	-200	678	272	490	304	435	2610
L	7500	-450	683	267	482	299	428	2568
M	7550	-675	686	264	568	352	503	3018
N	9100	725	692	268	911	565	805	4910
O	9150	550	690	260	429	27	389	2334
P	9225	275	688	262	458	284	408	2448
Q	9300	175	688	262	417	262	368	2208
R	9350	250	685	265	544	34	487	2922
S	10000		690	260	674	421	596	3576
T	Witt		125	57				

TABLE III: FP - TRACER EXPERIMENT NO. 3 (FIGS. SEE REPORT NO. 3)

Date : 7 July 1975

Duration of emission : 11.10 - 12.10 CET (60 min)

Area : Northern part of the valley

Wind direction : N - NE (Figs. 22, 23)

Mean wind speed between ground level and 300 m height : $U = 5.5$ m/s

Cloud cover / height : 1/10 - 2/10 Cu / 2500 m a.s.l.

Atmospheric stability : unstable (Fig. 24)

Stability class : B

Wind speed (m/s) Ascent (Fig.)

Oberau : $\bar{u}_1 = 5.0$ A - E (20)

Farchant : $\bar{u}_2 = 6.5$ C - D - G (21)

Mean : $U = 5.5$

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration (n/m ³)	Derived particle concentration (n/m ³)	Particle (P) concentration (n/m ³)
	X (m)	lateral direction Y (m)						
A	2850	750	653	297	191	118	118	118
B	3100	550	653	297	596	575	575	575
C	3225	275	653	297	870	559	559	559
D	3250	-800	656	294	279	173	173	173
E	4250	750	655	295	243	151	151	151
F	4425	550	655	295	227	178	178	178
G	4475	100	659	291	573	271	271	271
H	4650	-150	662	288	362	236	236	236
I	7550	650	677	273	295	157	157	157
J	7575	425	677	273	298	159	159	159
K	7700	125	678	272	291	160	160	160
L	7725	-150	683	267	283	175	175	175
M	7725	-375	689	264	298	169	169	169
N	9375	900	692	268	206	138	138	138
U	9400	725	696	264	208	129	129	129
P	9450	525	688	262	225	140	140	140
Q	9475	300	685	265	239	145	145	145
R	650	0	625	295	239	147	147	147
S	16475	0	746	210	258	198	198	198
T	4000	0	1350	850	90	151	151	151

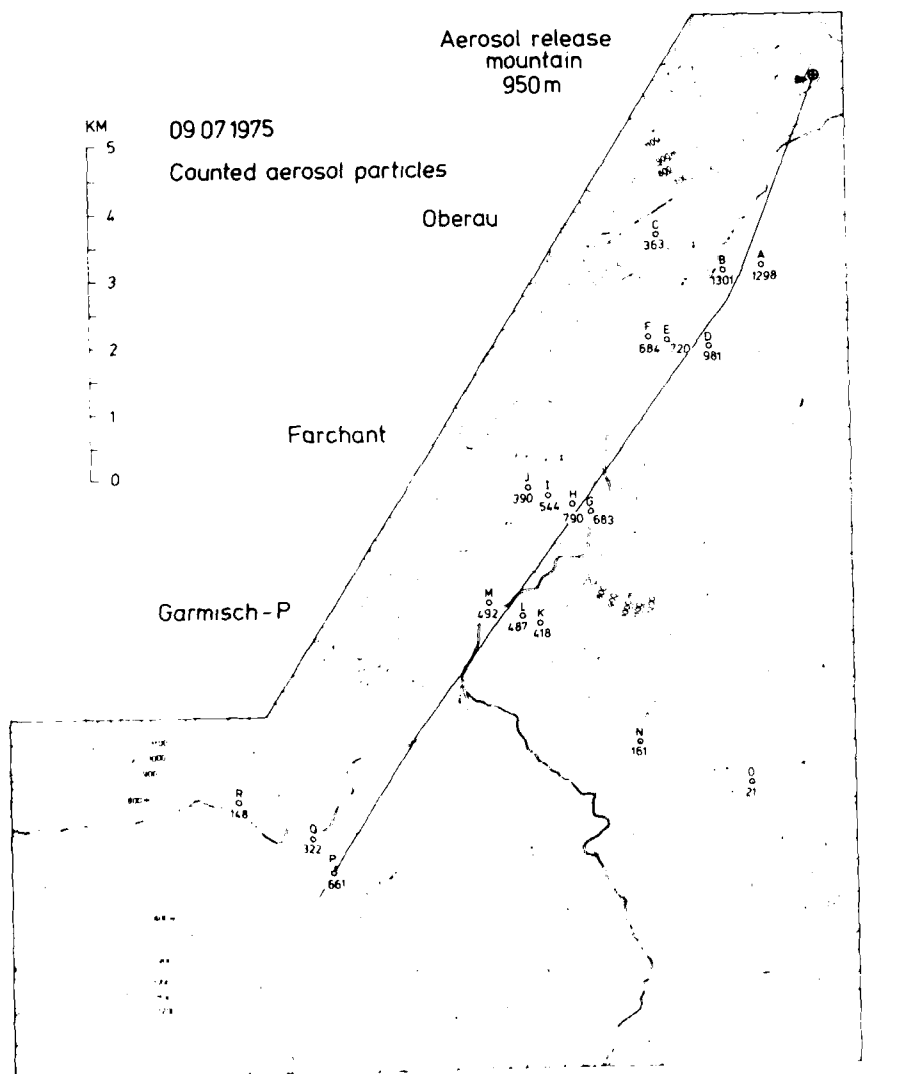


Fig. IV

TABLE IV: FP TRACER EXPERIMENT NO. 4 (FIGS. SEE REPORT NO. 7)

Date : 10 July 1975
 Duration (min) : 11.50 - 12.50 (11:00 min)
 Area : Northern part of the valley and summit of the Mt.
 Wind direction : N - NE (Fig. 29, 30)
 Mean wind speed between ground level and 300 m height : $\bar{U} = 4.5$ m/s
 Cloud cover / height : 5/10 Sc, Cu and 8/10 Ac / 2200 ft and 1.5 km respectively
 Atmospheric stability : slightly unstable to neutral (Fig. 41)
 Stability class : C (d)

Wind speed (m/s) Ascent (Fig. 4)
 Oberau : $\bar{U}_1 = 3.5$ B = C = 0 (27)
 Farchant : $\bar{U}_2 = 5.5$ b = E + F + I + J (28)
 Mean : $\bar{U} = 4.5$

Sampler	Distance		Altitude above sea level	Height differ- ence Source- Sampler	Number of particles (P) collected	Particle (P) concentration (P/m ³)	Derived (P) - concen- tration/10 min	Particle (P) Flux
	along axis	lateral direction						
	X (m)	Y (m)	h (m)	Δh (m)	\bar{P}_{60}	S_{60} P per m ³	$S_{10} = S$ (P per m ³)	S_U (P/m ² s)
A	2900	250	653	297	1298	805	1151	5180
B	3175	- 250	653	297	1301	807	1154	5193
C	3025	-1375	656	294	363	225	322	1449
D	4300	175	655	295	981	608	869	3911
E	4575	- 375	659	291	720	446	638	2871
F	4700	- 625	662	288	684	424	606	2727
G	7350	175	677	273	683	423	605	2723
H	7400	- 125	677	273	790	490	701	3155
I	7525	- 500	683	267	544	337	482	2169
J	7600	-800	686	264	330	242	346	1557
K	8125	- 625	692	258	418	259	370	1665
L	6200	250	688	262	487	300	432	1944
M	6500	275	686	265	442	276	431	1907
N	6725	275	686	265	141	100	143	644
O	6850	475	685	266	11	7	10	45
P	1500		64	11	111	47	68	303
Q	1500		64	11	51	31	44	195
R	1500	175	64	11	14	9	13	59
S								
T								

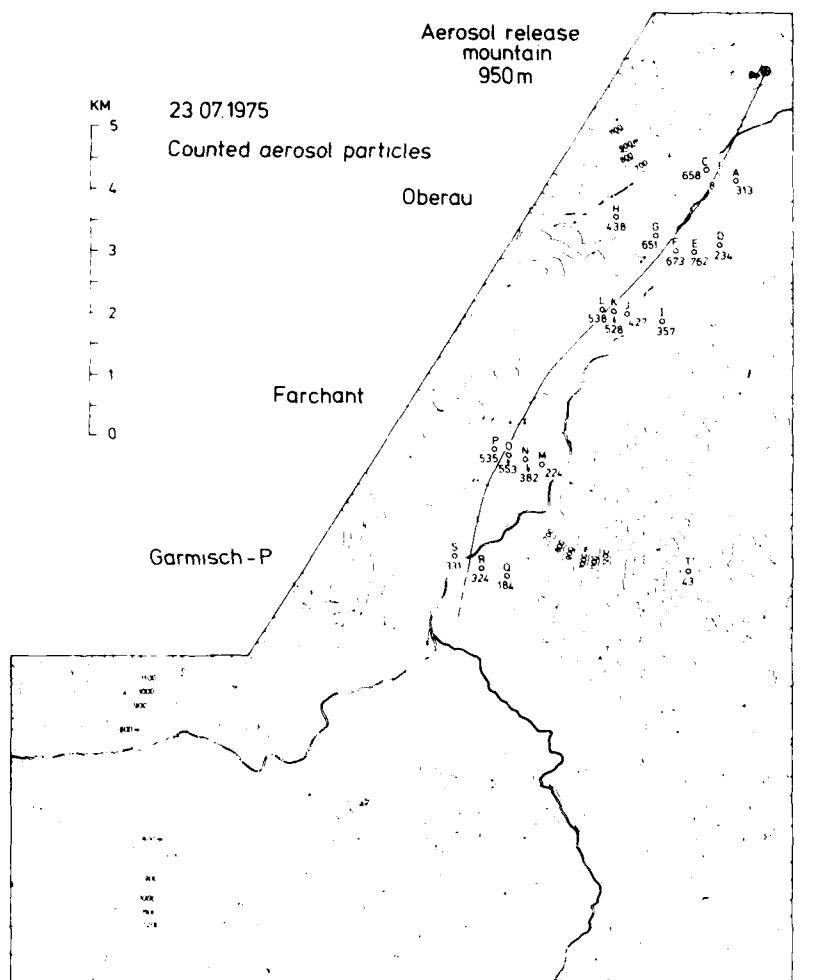


Fig.V

TABLE VI. (P) - TRACER EXPERIMENT NO. 1. (10), (11) REPORT NO. 1, 2

Date: 12/2/62, 12/3/62
 Duration of experiment: 12/2/62 - 12/3/62, 12/4/62
 Area: Northern California, near Los Angeles
 Wind direction: North-Northwest, Northwest
 Mean wind speed between ground level and 500 m height: 5.0 m/sec
 Cloud cover: height: 1710 - 2410 m, 2410 - 2710 m, 2710 - 3010 m
 Atmospheric stability: unstable - F1, F2
 stability class: F

Wind speed (m/sec) Altitude (m)
 Obsead: $\bar{U}_1 = 5.0$ C = 1.34
 Panchant: $\bar{U}_2 = 6.5$ D = E = F = 1.45
 Mean: $\bar{U} = 6.0$

Sampler	Distance		Altitude above sea level	Height differ- ence Source- Sampler	Number of particles (P) collected	Particle (P) concentration 5 th min	Derived (P) = concen- tration/10 min	Particle (P) = P10 (P2/m ³ s)
	along axis	lateral direction						
	X (m)	Y (m)	h (m)	h - H (m)	D ₁₀	S ₁₀ (P per m ³)	S ₁₀ = S (P per m ³)	S ₁₀ (P2/m ³ s)
A	1825	325	650	300	513	194	277	1962
B	1825	75	650	300	837	519	742	4452
C	1825	-175	650	300	658	408	513	3498
D	2725	675	653	297	234	145	207	1242
E	3650	475	653	297	762	471	675	4050
F	5025	150	653	297	673	417	596	3576
G	5375	-125	653	297	651	404	578	3468
H	5375	475	653	297	438	272	389	2334
I	425	75	656	296	867	531	746	4476
J	4425	175	654	294	407	265	379	2374
K	4675	75	654	294	528	327	468	2808
L	4725	75	654	294	534	334	478	2868
M	5275	675	653	297	234	145	207	1242
N	5425	875	653	297	740	457	654	3924
O	5500	275	653	297	517	327	468	2808
P	7025	175	653	297	77	47	67	402
Q	8025	875	653	297	234	145	207	1242
R	8425	75	653	297	517	327	468	2808
S	8725	275	653	297	517	327	468	2808
T	9025	875	653	297	234	145	207	1242

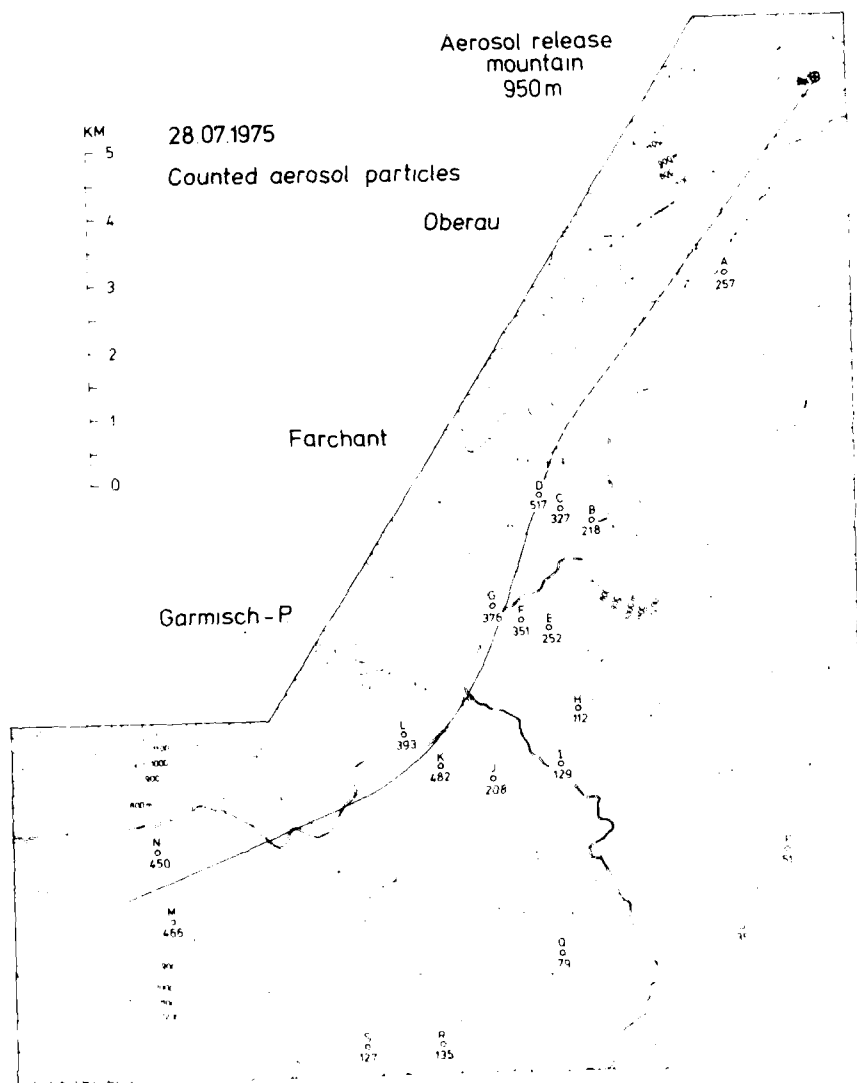


Fig.VI

TABLE VI: FP - TRACER EXPERIMENT NO. 1 (FIRST SEE REPORT NO. 3)

Date : 28 July 1975
 Duration of emission : 12.00 - 12.40 (17 min)
 Area : Northern part of the valley (altitude 600 m at least)
 Wind direction : N - NE (Figs. 44, 45, 46)
 Mean wind speed between ground level and 300 m height : $\bar{u} = 6.5$ m/s
 Cloud cover / height : 1/10 - 2/10 (at 2750 m a.s.l.)
 Atmospheric stability : slightly unstable to unstable (Fig. 47)
 Stability class : C - F

Wind speed (m/s) Ascent : Fig.
 Parchant : $\bar{u}_1 = 7.0$ A - B - F : 42
 Institute : $\bar{u}_2 = 6.5$ D - G - H : 43
 Mean : $\bar{u} = 6.5$

Sampler	Distance		Altitude above sea level	Height differ- ence Source- Sampler	Number of particles (P) collected	Particle (P) concentration 40 min	Derived (P) = concen- tration/10 min	Particle E. Fluo
	along axis	lateral direction						
	X	Y	h	h	D ₄₀	S ₄₀	S ₁₀ = S	S ₁₀
	(m)	(m)	(m)	(m)		(P per m ³)	(P per m ³)	(P per m ³)
A	3100	575	653	297	257	239	315	2048
B	7575	850	677	273	218	203	268	1740
C	7525	350	678	272	327	304	401	2600
D	7425	0	686	264	517	481	635	4128
E	4500	700	692	258	252	234	309	2009
F	9500	275	688	262	351	326	430	2796
G	4200	-200	685	265	376	350	462	3003
H	10175	1350	780	170	112	104	137	(891)
I	10850	1700	707	243	129	120	158	(1027)
J	11400	1900	707	243	208	193	255	1658
K	11675	300	707	243	482	448	591	3842
L	11675	-425	715	235	393	365	482	3133
M	16150	525	770	180	466	433	572	3718
N	15950	-525	740	210	450	419	553	3595
O	Eckbauer		1200	-250	35	33	44	-
P	Wamborn		1050	-100	51	47	62	-
Q	Bayern Park		1250	-300	74	73	96	-
R	Kreuzloch		1700	-750	135	126	166	-
S	Kreuzeck		1650	-700	127	118	150	-
T								-

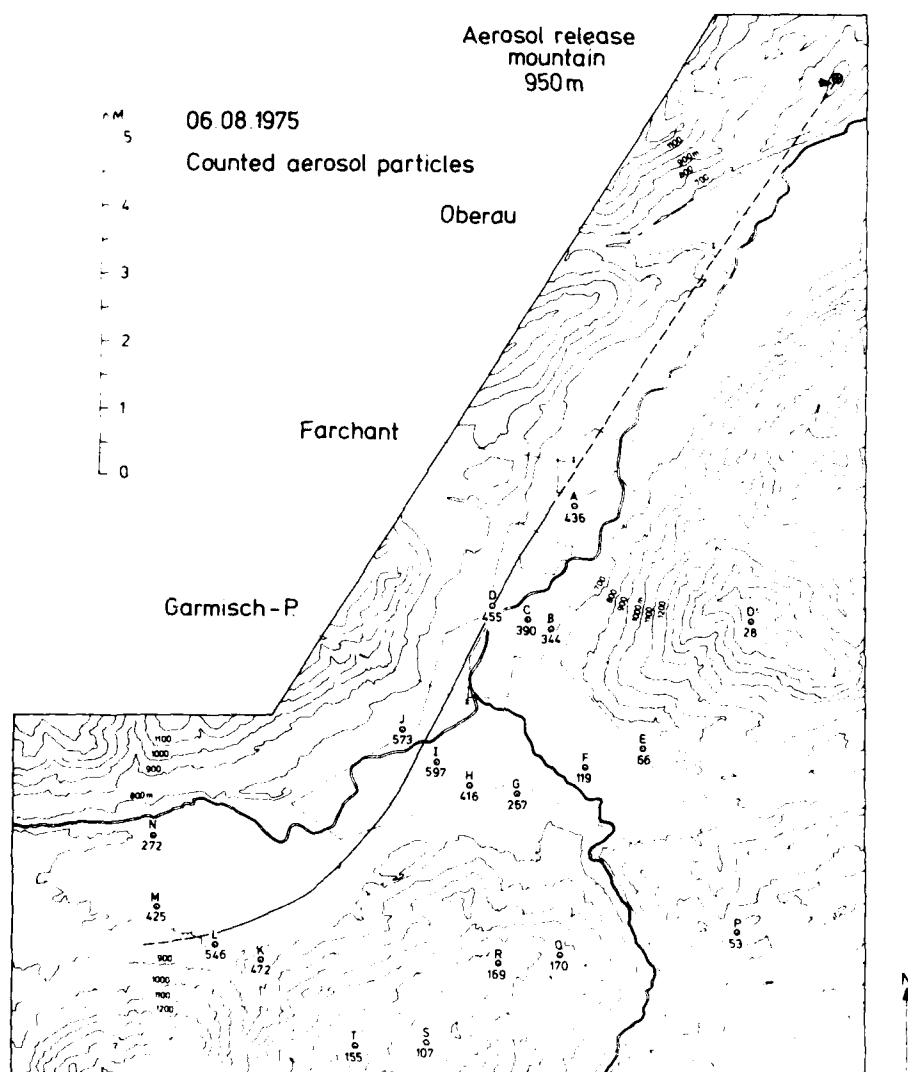


Fig.VII

TABLE VII: EP - TRACER EXPERIMENT NO. 7 (FIG. 5). SEE REPORT NO. 5

Date : 16 August 1975
 Duration of emission : 11.50 - 12.10 (ET - 60 min)
 Area : Northern part of the valley, from 7.24 to 12.410 m altitude
 Wind direction : N - NE (Fig. 52, 53, 54)
 Mean wind speed between ground level and 300 m height : $\bar{U} = 6.0$ m/s
 Cloud cover / height : 3/10 - 4/10 Cu / 2500 m a.s.l.
 Atmospheric stability : Indifferent to slightly unstable, base of isothermal layer or inversion 320 m altitude (Fig. 55)
 Stability class : C (D)

Wind speed (m/s) Ascent (Fig.)
 Burgram : $\bar{U}_1 = 7.0$ R - E (50)
 Institute : $\bar{U}_2 = 5.5$ D - G - H (51)
 Mean : $\bar{U} = 6.0$

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 40 min	Derived (P) - concentration/40 min	Particle (P) Flux
	X	lateral direction Y						
	(m)	(m)	h (m)	z-h (m)	D_{40}	S_{40} (P per m ³)	$S_{10} \pm S$ (P per m ³)	SL (P/m ² s)
A	7375	300	678	272	436	405	535	3210
B	9250	925	692	258	344	330	425	2532
C	9250	550	688	262	306	363	475	2874
D	9250	0	685	265	455	423	558	3348
E	10150	2925	780	170	66	61	81	4863
F	10825	2275	710	240	113	111	142	8823
G	11600	1525	707	243	267	248	322	1962
H	11800	875	707	243	416	382	511	3066
I	11725	275	707	243	302	303	333	4348
J	11500	-400	715	235	323	333	704	4224
K	15375	525	900	50	472	439	529	3424
L	15900	150	800	150	540	508	621	4026
M	16675	550	770	180	405	363	521	3126
N	16575	-1000	740	210	272	253	324	2004
O	Wank		1280	830	28	20	34	216
P	Eckbauer		1290	820	23	14	23	144
Q	Bayerhof		1250	860	15	10	16	102
R	Grimm - 90° - 1000		1350	760	10	7	10	66
S	Kronach		1200	910	12	8	13	84
T	Kronach		1020	1090	12	8	13	84

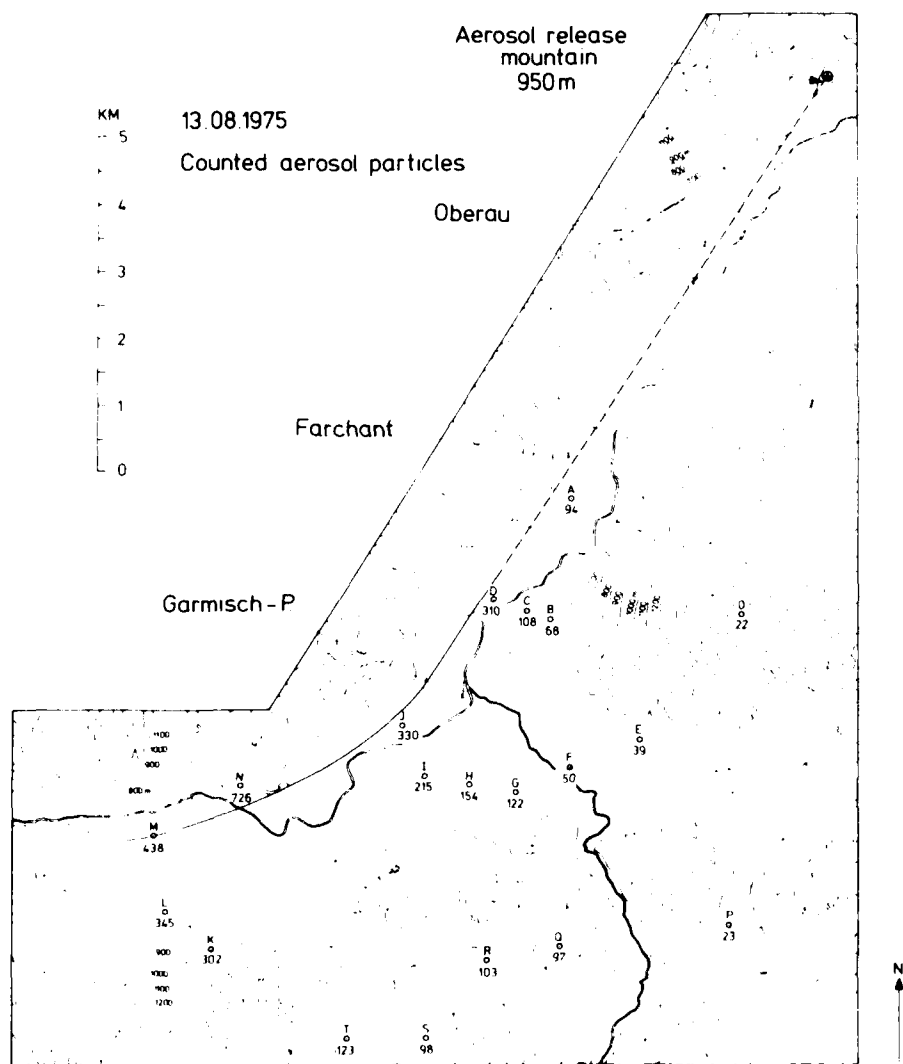


Fig.VIII

TABLE VIII: FP - TRACER EXPERIMENT NO. 8 (FIGS. SEE REPORT NO. 3)

Date : 13 August 1975
 Duration of emission : 12.00 - 12.40 CET (40 min)
 Area : Northern part of the valley, Garmisch basin, mountain side
 Wind direction : N - NE (Figs. 60, 61, 62)
 Mean wind speed between ground level and 300 m height : $U = 5.0$ m/s
 Cloud cover / height : 4/10 - 5/10 Cu / 2500 m a.s.l.
 Atmospheric stability : slightly unstable, base of inversion 675 m aloft (Fig. 57)
 Stability class : C

Wind speed (m/s) Ascent (Fig. 5)
 Burgrain : $U_1 = 6.0$ R - C = 6 (58)
 Institute : $U_2 = 4.0$ E - F = 1 (54)
 Mean : $U = 5.0$

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 40 min	Derived (P) - concentration/10 min	Particle (P) - Flux
	X	lateral direction Y						
	km	km	km	km	D_{40}	S_{40} (P per m ³)	$S_{10} = S_{40}/4$ (P per m ³)	$S_{40} \cdot h$ (P/m ²)
A	7325	275	678	272	94	87	115	575
B	8975	1025	692	258	68	63	83	415
C	9075	675	688	262	108	100	132	660
D	9225	150	685	265	310	288	380	1900
E	9775	3125	780	170	39	36	48	(240)
F	10700	2475	710	240	50	47	62	(310)
G	11250	2075	707	243	122	113	149	745
H	11425	1500	707	243	154	143	189	945
I	11700	975	707	243	215	200	264	1320
J	11500	175	715	235	330	307	405	2025
K	15275	1875	800	150	302	281	371	1855
L	15700	1150	770	180	345	321	424	2120
M	15550	0	740	210	438	407	537	2685
N	14050	-300	800	150	726	675	891	(4455)
O	Wank		1280	-850	22	20	26	-
P	Eckbauer		1200	-250	23	21	28	-
Q	Bayerh. Harz		1250	300	27	90	119	-
R	Garmisch-Harz Harz		1350	-380	103	96	127	-
S	Kreuzbach		1290	250	98	91	120	-
T	Kreuzbach		1650	200	123	114	150	-

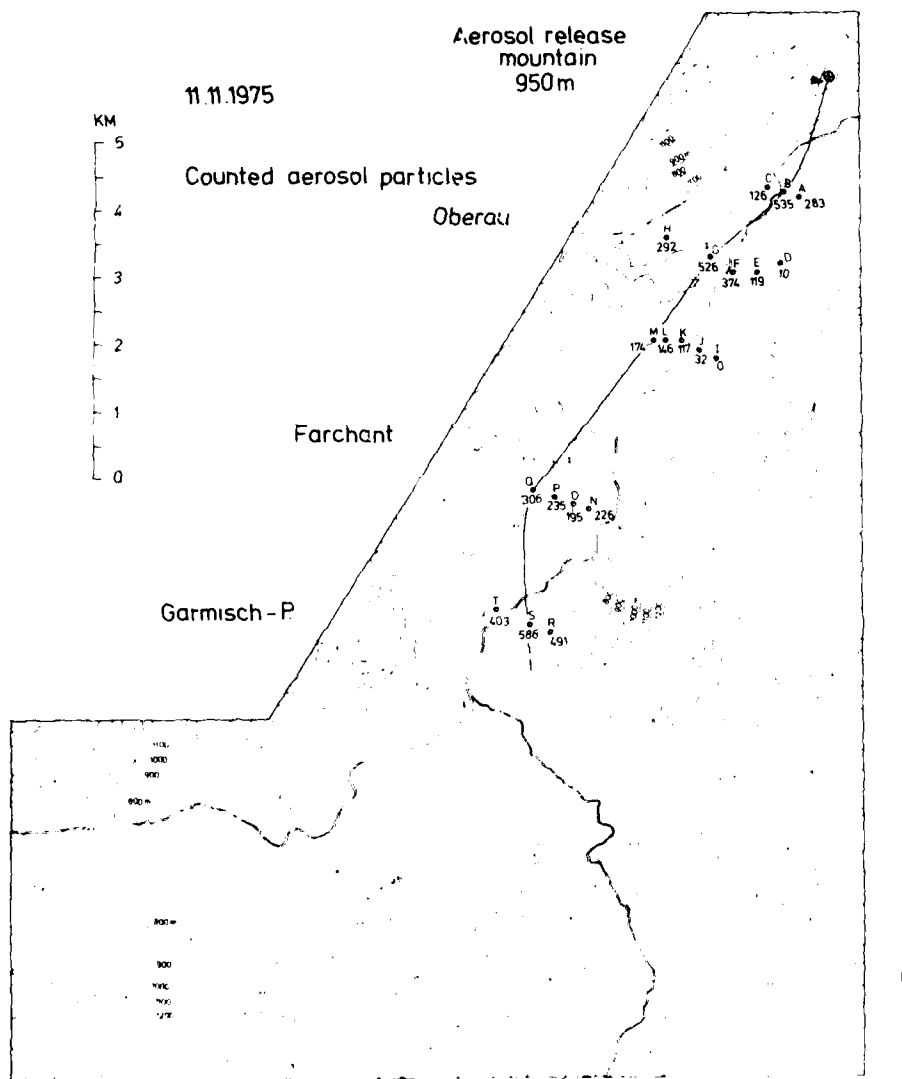


Fig.IX

TABLE IX: FP - TRACER EXPERIMENT NO. 9 (FIGS. SEE REPORT NO. 4)

Date : 11 November 1975
 Duration of emission : 12.45 - 13.25 CET (40 min)
 Area : Northern part of the valley
 Wind direction : NE (Figs. 5, 6, 7, 8)
 Mean wind speed between ground level and 300 m height : $U = 5.5$ m/s
 Cloud cover / height : Cloudless
 Atmospheric stability : Neutral, base of temperature inversion between 200 and 400 m (Fig. 9)
 Stability class : D

Wind speed (m/s) Ascent (Fig.)
 Oberau : $\bar{u}_1 = 5.5$ C - G - H (3)
 Farchant : $\bar{u}_2 = 6.0$ F - I - J (4)
 Mean : $U = 5.5$

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 40 min	Derived (P) - concentration/10 min	Particle (P) Flux
	X	lateral direction Y						
	(m)	(m)	h (m)	h (m)	N_{40}	S_{40} (P per m ³)	$S_{10} = S$ (P per m ³)	SU (P/(m ² s))
A	1750	225	645	305	283	263	347	1909
B	1850	0	645	305	535	498	657	3614
C	1950	-225	645	305	126	117	154	847
D	2575	725	655	295	10	0	0	0
E	2900	625	650	300	119	111	147	809
F	3175	175	650	300	374	348	459	2525
G	3300	0	655	295	526	489	645	3548
H	3425	-700	655	295	292	272	359	1975
I	4425	950	660	290	0	0	0	0
J	4475	675	660	290	32	30	40	220
K	4525	375	660	290	117	109	144	792
L	4650	175	665	285	146	136	180	990
M	4775	50	665	285	174	162	214	1177
N	7325	800	665	285	226	210	277	1524
O	7425	575	665	285	195	181	239	1315
P	7500	500	680	270	235	219	289	1590
Q	7625	0	680	270	306	285	376	2098
R	9750	325	680	270	491	457	603	3317
S	9825	0	680	270	586	545	719	3955
T	9875	-400	680	270	403	375	495	2723

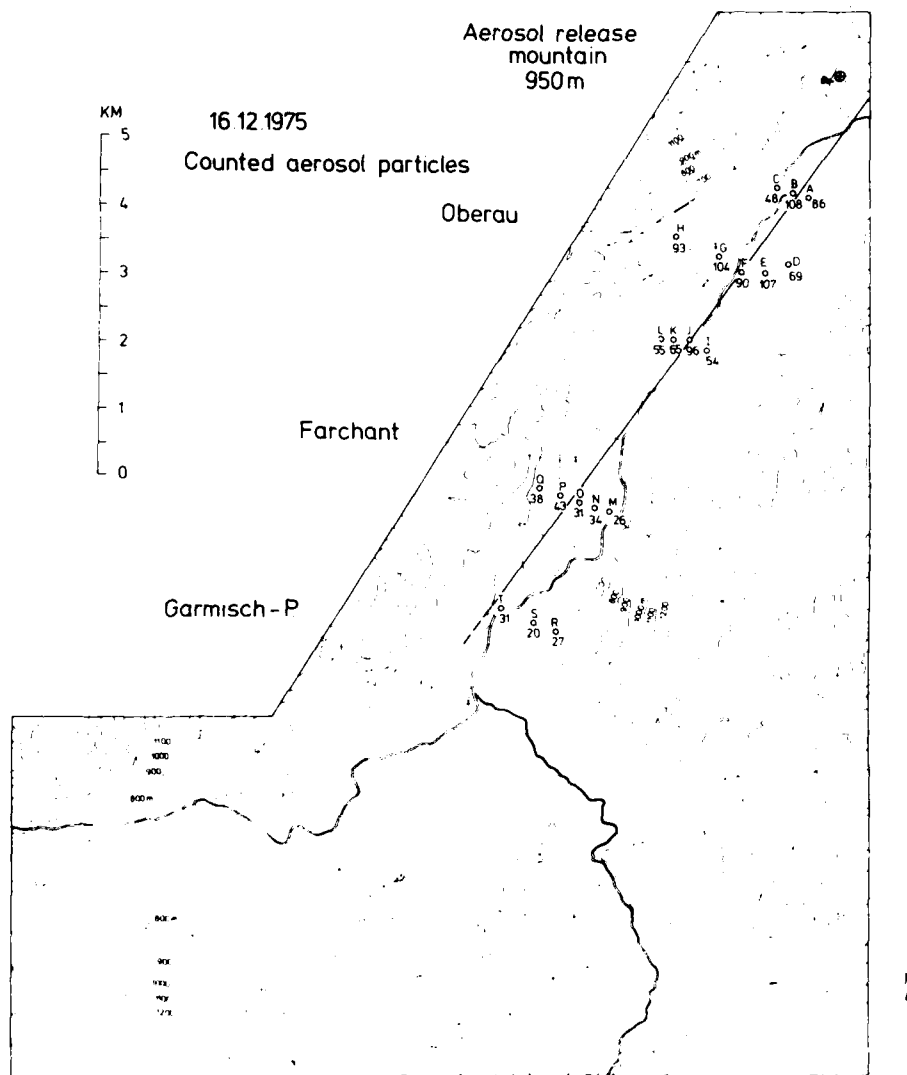


Fig.X

TABLE X: FP - TRACER EXPERIMENT NO. 10 (FIGS. SEE REPORT NO. 4)

Date : 16 December 1975
 Duration of emission : 13.00 - 13.40 CET (40 min)
 Area : Northern part of the valley
 Wind direction : NE within a shallow (100 m) bottom layer, above that SSW (foehn), see ascent F (Fig. 12)
 Wind speed : Within the cold, shallow bottom layer weak wind velocities (1-2 m/s), above that - within the foehn current - wind speeds up to 4 m/s at 500 m height, see ascent F (Fig. 12)
 Cloud cover / height : 9/10 - 10/10 Cs, drifting stratus banks in the valley
 Atmospheric stability : lifted ground based inversion (base between 100 and 300 m), see Figs. 18 and 19
 Stability class : Undefined

Sampler	Distance along axis (lateral direction)		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 40 min	Derived (P) - concentration/10 min	Particle (P) Flux
	X (m)	Y (m)				$S_{40} = \frac{P}{40 \text{ min}}$	$S_{10} = \frac{P}{10 \text{ min}}$	$S_{10} \cdot h$
A	1700	150	645	305	86	80	106	-
B	1775	- 75	645	305	108	100	132	-
C	1850	- 300	645	305	48	45	59	-
D	2650	500	655	295	69	64	84	-
E	2975	300	650	300	107	96	127	-
F	3175	0	650	300	90	84	111	-
G	3175	- 400	655	295	104	97	128	-
H	3300	- 1075	655	295	93	86	114	-
I	4425	300	660	290	54	50	66	-
J	4425	0	660	290	96	89	117	-
K	4550	- 200	665	285	65	60	79	-
L	4675	- 350	665	285	55	51	67	-
M	7150	575	665	285	26	24	32	-
N	7250	350	665	285	34	32	42	-
O	7325	125	665	285	31	29	38	-
P	7400	- 150	680	270	45	40	53	-
Q	7500	425	690	260	58	53	70	-
R	9050	1900	680	270	27	25	33	-
S	9150	650	680	270	26	24	32	-
T	9250	125	680	270	31	29	38	-

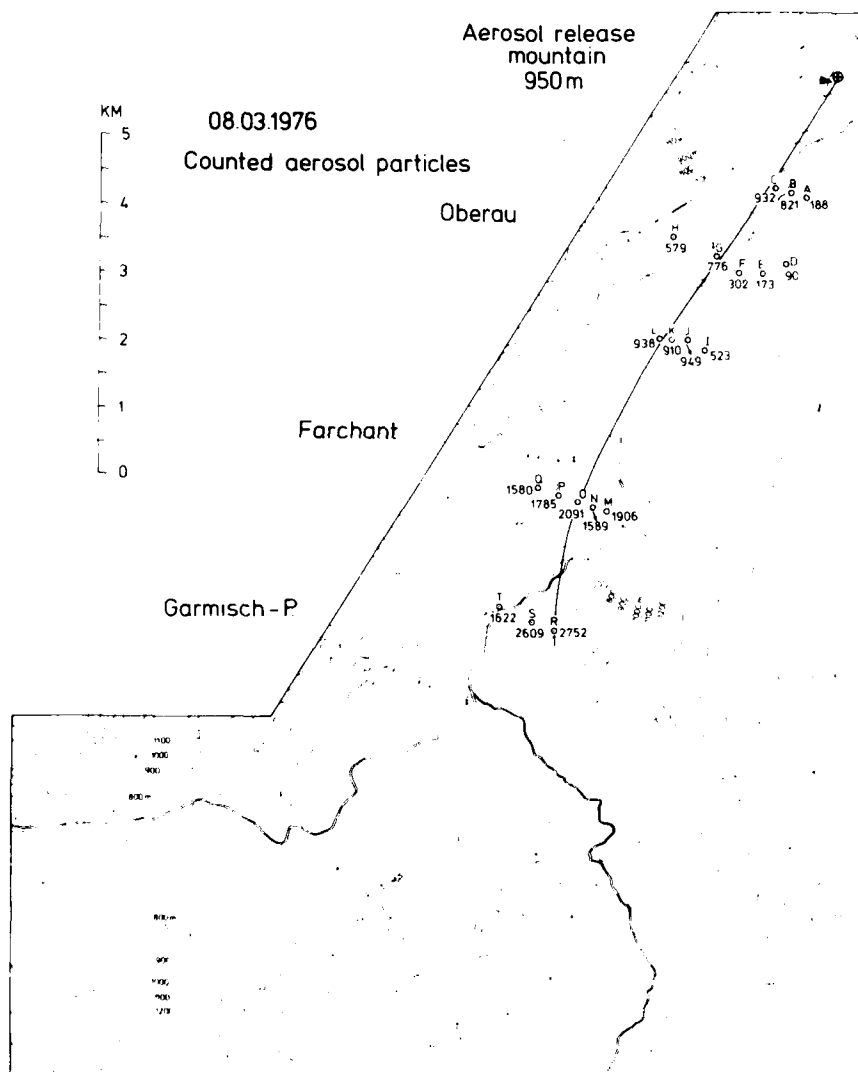


Fig.XI

TABLE XI: FP - TRACER EXPERIMENT NO. 11 (FIGS. SEE REPORT NO. 4)

Date : 8 March 1976
 Duration of emission : 11.30 - 12.30 CET (60 min)
 Area : Northern part of the valley
 Wind direction : NE (Figs. 23, 24, 25)
 Mean wind speed between ground level and 300 m height : $U = 5.0$ m/s
 Cloud cover / height : 3/10 Sc, 10/10 As / 1400 - 1700 m (Sc), As > 3000 m a.s.l.
 Atmospheric stability : Elevated temperature inversion (base: 300 - 400 m) above a slightly stable bottom layer (Fig. 26)
 Stability class : D

Wind speed (m/s) Ascent (Fig.)
 Farchant : $\bar{U}_1 = 5.0$ B - C - D - E (22)
 Mean : $U = 5.0$

Sampler	Distance		Altitude above sea level	Height differ- ence Source- Sampler	Number of particles (P) collected	Particle (P) concentration 60 min	Derived (P) - concen- tration/10 min	Particle (P) Flux
	along axis	lateral direction				S_{60} (P per m ³)	$S_{10} = S$ (P per m ³)	SU (P/m ² s)
	X (m)	Y (m)	h (m)	-h (m)	D ₆₀			
A	1700	525	645	305	188	117	167	835
B	1775	300	645	305	821	509	728	3640
C	1825	75	645	305	932	578	827	4135
D	2650	850	655	295	90	56	80	400
E	2975	625	650	300	173	107	153	765
F	3150	350	650	300	302	187	267	1335
G	3150	- 75	655	295	776	481	688	3440
H	3250	-750	655	295	579	359	513	2565
I	4400	575	660	290	523	324	463	2315
J	4400	275	660	290	949	588	841	4205
K	4550	75	665	285	910	564	807	4035
L	4625	- 50	665	285	938	582	832	4160
M	7250	425	665	285	1906	1182	1690	8450
N	7250	200	665	285	1589	985	1409	7045
O	7250	- 50	665	285	2091	1296	1853	9265
P	7250	-350	680	270	1785	1107	1583	7915
Q	7250	-650	690	260	1580	980	1401	7005
R	9250	0	680	270	2752	1706	2440	12200
S	9075	-350	680	270	2609	1618	2314	11575
T	8925	-825	680	270	1527	959	1359	7105

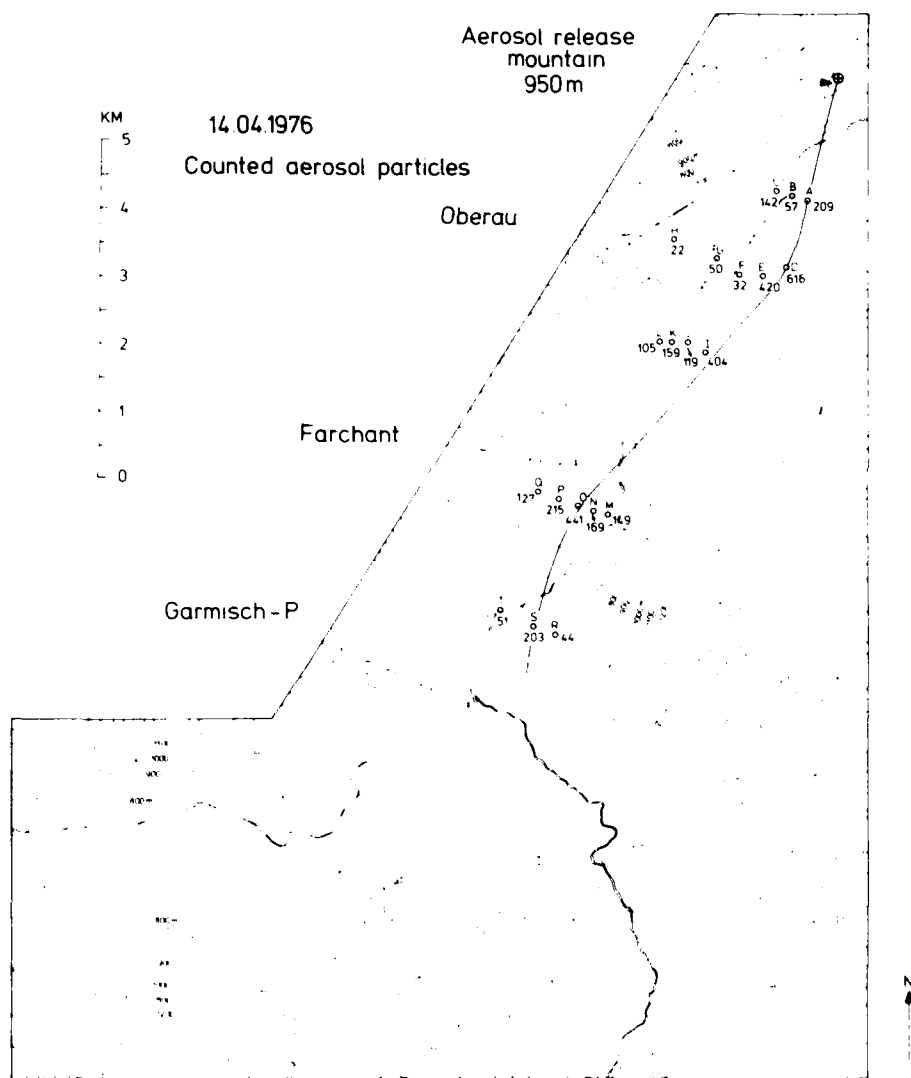


Fig.XII

TABLE XII: FP - TRACER EXPERIMENT NO. 12 (FIGS. SEE REPORT NO. 4)

Date : 14 April 1976

Duration of emission : 10.15 - 11.00 CFT (45 min)

Area : Northern part of the valley

Wind direction : Highly unsteady during the experiment, i.e., NE at the beginning and the end (points E and D, Figs. 30, 31), or S in between (point C, Fig. 31), respectively

Mean wind speed between ground level and 300 m height : Weak velocities of 1-2 m/s (Fig. 29); derivation of a mean value with respect to changing wind directions not meaningful

Cloud cover / height : 8/10 Cu with subsequent clearing up / 2800 m a.s.l.

Atmospheric stability : neutral to slightly unstable (Fig. 34)

Stability class : C

Sampler	Distance along axis lateral direction		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 45 min	Derived (P) = concentration/10 min	Particle (P) Flux
	X (m)	Y (m)				S_{45} (P per m ³)	$S_{10} = S$ (P per m ³)	
A	1800	0	645	305	209	173	234	-
B	1750	- 275	645	305	57	47	63	-
C	1725	- 525	645	305	142	118	159	-
D	2750	0	655	295	616	511	699	-
E	3125	- 250	650	300	420	349	471	-
F	3300	- 500	650	300	32	27	36	-
G	3300	- 925	655	295	50	42	57	-
H	3575	-1575	655	295	22	18	24	-
I	4525	- 125	660	290	404	335	452	-
J	4550	- 425	660	290	119	99	134	-
K	4700	- 600	665	285	159	132	178	-
L	4825	- 750	665	285	105	87	117	-
M	7375	375	665	285	140	124	167	-
N	7425	200	665	285	160	140	189	-
O	7475	- 50	665	285	441	366	494	-
P	7525	- 550	680	275	215	178	240	-
Q	7575	- 650	690	265	127	105	142	-
R	9450	325	680	275	45	37	50	-
S	9375	- 50	680	275	277	228	307	-
T	9300	550	680	275	51	41	57	-

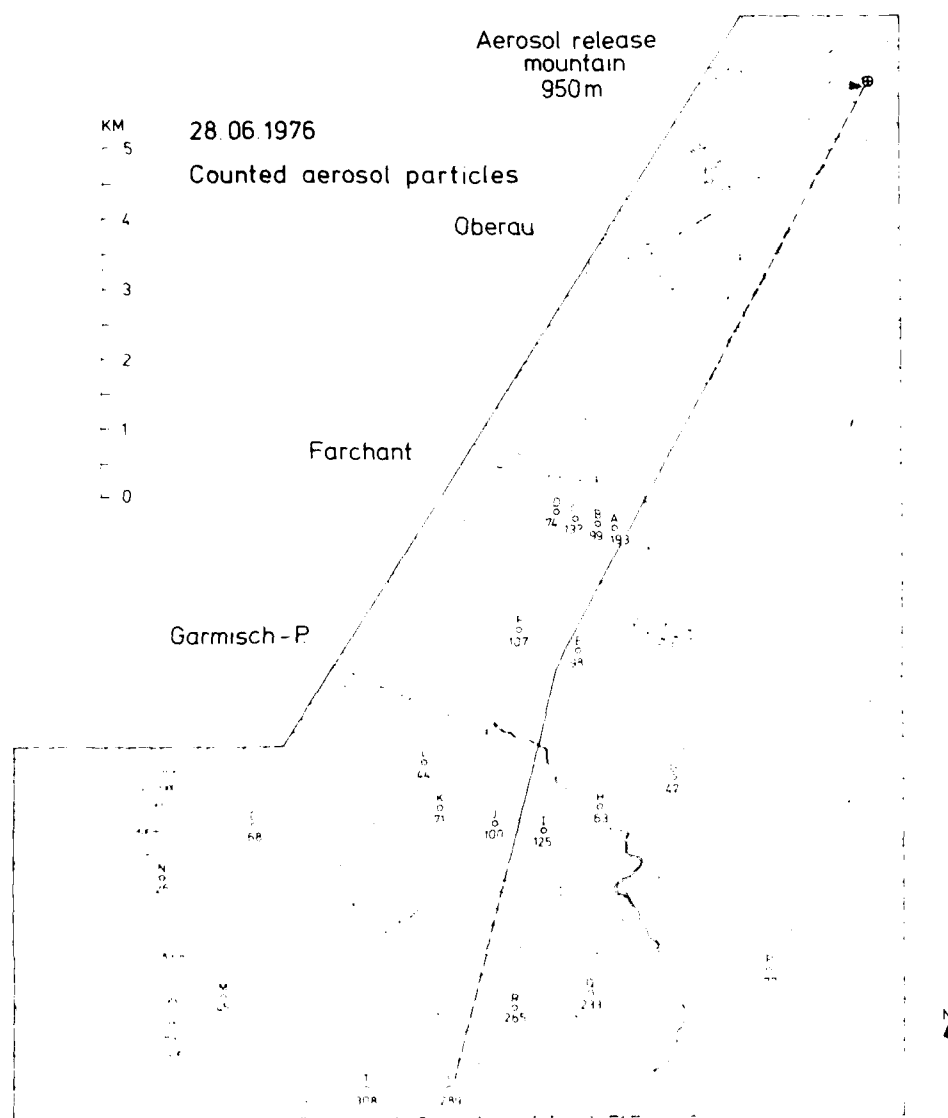


Fig.XIII

TABLE XIII: FP - TRACER EXPERIMENT NO. 13 (FIGS. SEE REPORT NO. 4)

Date : 26 June 1976
 Duration of emission : 11:00 - 11:45 (ET - 145 min)
 Area : Northern part of the valley, Garmisch-Partenkirchen
 Wind direction : NNE - NE (Figs. 39, 40, 41)
 Mean wind speed between ground level and 300 m height : $\bar{U} = 6.0$ m/s
 Cloud cover / height : 3/10 - 4/10 (u / 3000 m level)
 Atmospheric stability : unstable (Fig. 42)
 Stability class : B (C)

Wind speed (m/s) Ascent (Fig.)
 Farchant : $\bar{U}_1 = 6.0$ B - E (37)
 Institute : $\bar{U}_2 = 6.0$ D - G - H (38)
 Mean : $\bar{U} = 6.0$

Sampler	Distance		Altitude above sea level	Height differ- ence Source- Sampler	Number of particles (P) collected	Particle (P) concentration 45 min	Derived (P) - concen- tration/10 min	Particle (P) Flux
	along axis	lateral direction						
	X	Y	h	h	D ₄₅	S ₄₅ (P per m ³)	S ₁₀ = S (P per m ³)	SU (P/m ² s)
	(m)	(m)	(m)	(m)				
A	7325	-200	665	285	193	160	216	1296
B	7375	-425	670	280	99	82	111	666
C	7450	-750	680	270	133	110	149	894
D	7500	-1050	690	260	74	61	82	492
E	9100	175	680	270	98	81	109	654
F	9250	-725	680	270	107	89	120	720
G	10625	1950	780	170	47	39	53	318
H	11275	1050	710	240	63	52	70	420
I	11800	375	710	240	125	104	140	840
J	11850	-325	710	240	100	83	112	672
K	11875	-1125	710	240	71	59	80	480
L	11275	-1500	715	235	44	37	50	300
M	(15175)	(-3450)	820	130	46	37	50	-
N	(13750)	(-4725)	740	210	26	22	30	-
O	(12725)	(-3625)	800	150	68	56	76	-
P	Eckbauer		1200	-250	77	64	86	-
Q	Bayern Haus		1250	-300	233	193	261	-
R	Garmischer Haus		1330	-380	265	220	297	-
S	Kreuzjoch		1700	-750	289	240	324	-
T	Kreuzerk		1650	-700	308	256	346	-

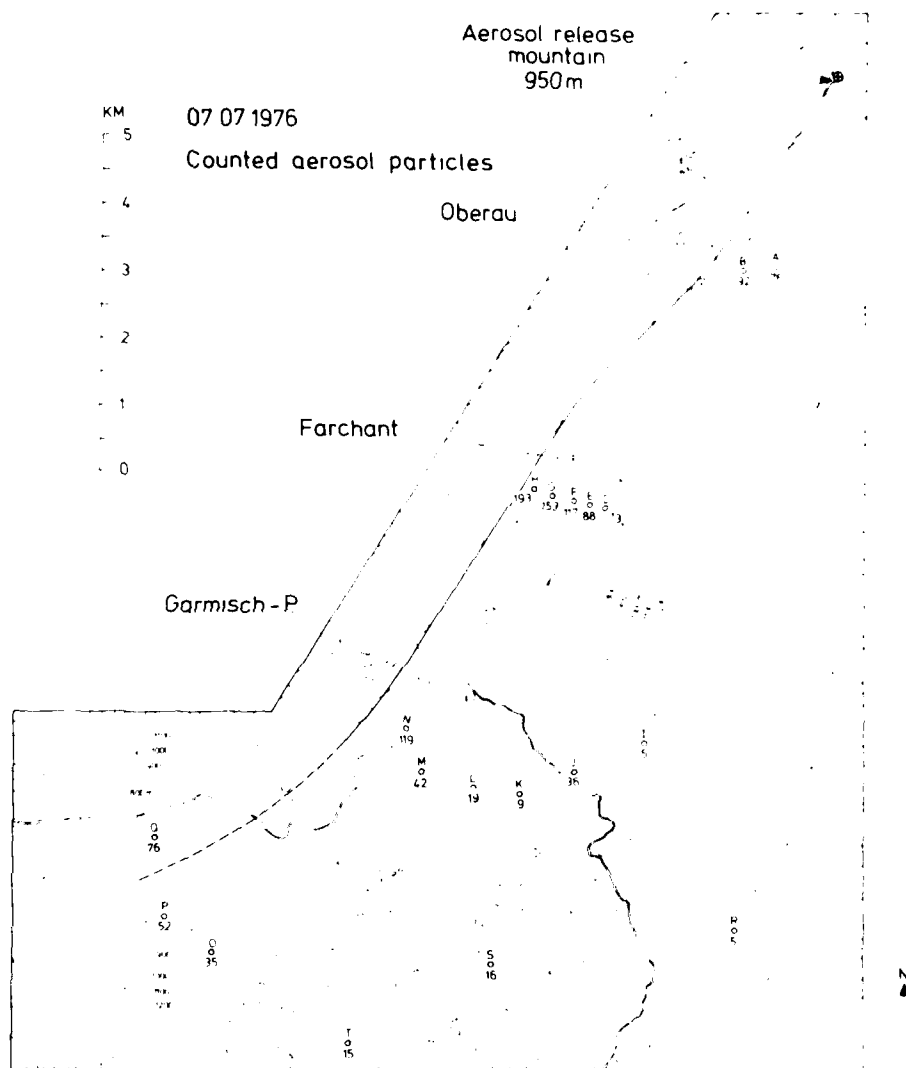


Fig.XIV

TABLE XIV: FP - TRACER EXPERIMENT NO. 14 (FIGS. SEE REPORT NO. 4)

Date : 7 July 1976
 Duration of emission : 10.30 - 11.30 CET (60 min)
 Area : Northern part of the valley, Garmisch basin, mountain sites
 Wind direction : NNE, NE (Figs. 47, 48, 49, 50)
 Mean windspeed between ground level and 300 m height : $U = 7.0$ m/s
 Cloud cover / height : 1/10 Cu and 4/10 Ci / 3500 m and 10 000 m a.s.l.
 Atmospheric stability : unstable (Fig. 51)
 Stability class : B

	Wind speed (m/s)	Ascent (Fig.)
Farchant :	$\bar{U}_1 = 6.5$	B - D - E - F (45)
Institute :	$\bar{U}_2 = 7.5$	G - H - I - L (46)
Mean :	$U = 7.0$	

Sampler	Distance along axis		Altitude above sea level	Height difference Source-Sampler	Number of particles (P) collected	Particle (P) concentration 60 min	Derived (P) - concentration/10 min	Particle (P) Flux
	X	lateral direction Y						
	(m)	(m)	h (m)	h (m)	D_{60}	S_{60} (P per m ³)	$S_{10} = S$ (P per m ³)	SU (P/(m ² s))
A	2850	800	655	295	76	47	67	469
B	3175	450	650	300	92	57	82	574
C	3250	-650	655	295	77	48	69	483
D	7375	1225	665	285	73	45	64	448
E	7450	1000	665	285	88	55	79	553
F	7525	750	665	285	117	73	104	728
G	7625	450	680	270	153	95	136	952
H	7700	175	690	260	193	121	172	1204
I	10000	3625	780	170	5	0	0	0
J	10925	2975	710	240	36	22	31	212
K	11650	2500	710	240	9	5	7	50
L	11650	1900	710	240	19	12	17	119
M	12000	1150	710	240	42	26	37	254
N	11650	600	715	235	119	74	106	742
O	15625	1475	820	130	35	22	31	212
P	16025	700	790	160	52	32	45	317
Q	15600	-450	740	210	76	47	67	469
R	Farchant		1200	-250	5	0	0	0
S	Garmischer Hah		1330	-380	16	10	14	100
T	Kreuzberg		1650	-700	15	9	13	90

